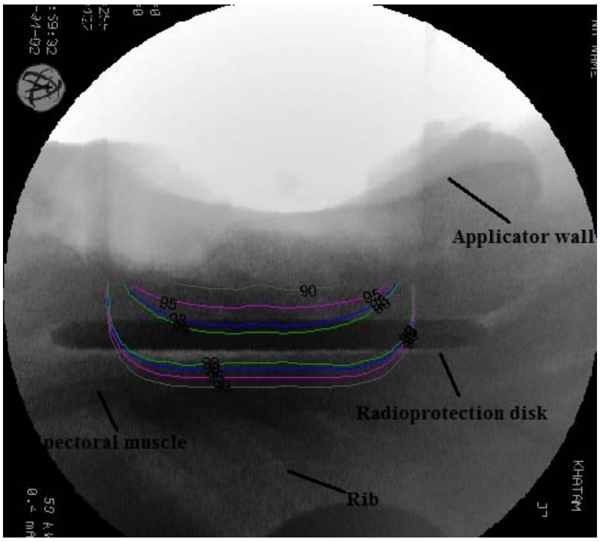

As it can be seen, the developed treatment planning system is able to clearly show the variations of isodose levels at the site of tumor bed. Therefore, treatment team can precisely determine the interested isodose level for the dose prescription.The results of in vivo dosimetry at the surface of tumor bed showed there is no meaningful difference between the measured and expected dose at the surface of tumor bed (P-value=0.92).

Conclusion: The feasibility of intraoperative imaging and development of a postoperative image based treatment planning system during breast cancer IOERT was investigated in this study. The results of in vivo dosimetry confirm the validity of the developed treatment planning system for clinical applications.

PO-0852
The dose in marrow of iliac plates during radiotherapy of cervical and endometrial cancer

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Purpose or Objective: To compare the differences between average doses cumulated in the marrow of iliac plates (PBM), obtained for five different radiotherapy strategies of cervical and endometrial cancer.

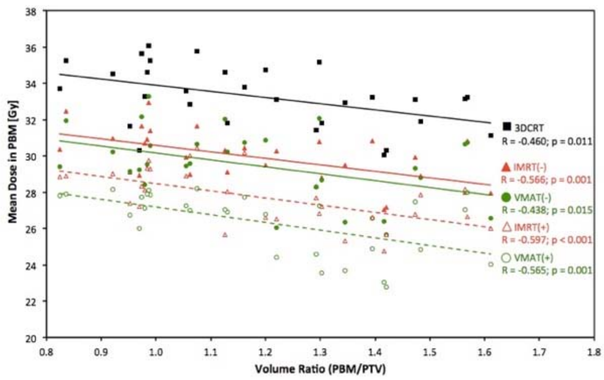
Material and Methods: A total of 150 treatment plans were calculated retrospectively for 30 patients with cervical and endometrial cancer.
For each case, 3 different dose delivery techniques were used. It were respectively: (i) 4-field, X15MV, 3DCRT; (ii) 7-field, X6MV, IMRT; and (iii) 2-arc, X6MV, VMAT. Two strategies were used during preparation of the IMRT and VMAT plans. The first take into account (+) PBM during optimization of the dose distribution and the second, do not take it into account (-).
All plans were normalized on the median dose in PTV. The same calculation algorithm (AAA) was used for calculation of the dose for each of plan. The total dose was 50.4 Gy (1.8 Gy in 28 fractions).
Average doses cumulated in PTV, PBM, bladder, rectum, bowels and femoral heads obtained from the evaluated plans were compared. In addition, the doses accumulated in PBM were analyzed in the light of the volume of PTV and/or PBM.
The statistical analysis were performed by Friedman ANOVA with Nemenyi's procedures used as post-hoc tests. In order to find the relationship between doses in PBM and volume of PTV and/or PBM, the Spearman correlation was used. All tests were performed on the significance level equal to 0.05.

Results: Table 1 shows the result of the comparison of the average dose in the light of the generated plans.

Technique	PTV	PBM	Bladder	Rectum	Bowels	FHR	FHL
	Average Dose (Standard Deviation) [Gy]						
3DCRT	50.4 (0.1)	33.3 (1.7)	49.9 (0.4)	47.7 (1.6)	37.6 (2.4)	38.2 (1.2)	38.3 (2.8)
IMRT(-)	50.4 (0.1)	29.9 (1.5)	35.4 (1.7)	36.2 (3.0)	32.6 (1.3)	25.4 (1.3)	27.7 (1.6)
VMAT(-)	50.4 (0.1)	29.4 (2.0)	34.6 (2.4)	35.7 (2.6)	33.2 (1.1)	26.3 (1.8)	28.7 (1.7)
IMRT(+)	50.5 (0.1)	27.7 (1.5)	35.5 (2.9)	36.3 (2.8)	32.6 (1.3)	23.9 (1.4)	24.4 (2.2)
VMAT(+)	50.4 (0.1)	26.4 (1.7)	34.6 (2.8)	35.7 (2.9)	32.9 (1.1)	24.1 (1.2)	25.0 (2.0)
Technique	Similarity/Dissimilarity of the results						
	p = 0.998	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.007	p < 0.011
3DCRT	A	A	A	A	A	A	A
IMRT(-)	A	B	B	B	B	B	B
VMAT(-)	A	B	B	B	B	B	B
IMRT(+)	A	C	B	B	B	C	C
VMAT(+)	A	C	B	B	B	C	C

PTV - Planning Target Volume; PBM - The bone marrow in the iliac plates; FHR - right femoral head; FHL - left femoral head

The average dose in PTV for evaluated plans was similar. The worst doses in organs at risk were obtained for 3DCRT. Using the PBM during optimization of IMRT and VMAT reduces the average dose in PBM without increasing the doses in bladder, rectum and bowels. Differences between doses in PBM for IMRT and VMAT plans, where PBM was used during optimization, were not statistically significant. The correlation between mean dose in PBM and the volume ratio of PBM and PTV was found for each technique (Figure 1).



Conclusion: Using the PBM during optimization of the IMRT and VMAT plans effectively reduces the dose in PBM without increasing the dose in bladder, rectum and bowels. The doses, obtained in PBM for IMRT and VMAT are not statistically different. Decreasing the PBM volume in relation to PTV increases the mean dose in PBM.

PO-0853
Impact of CT modality used for treatment planning of lung SBRT

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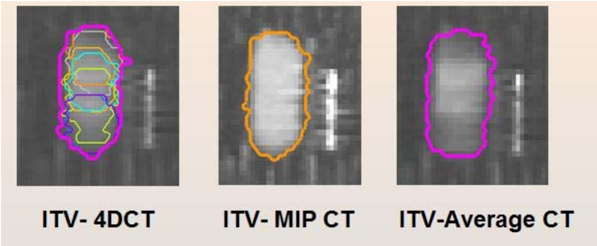
Purpose or Objective: The introduction of lung stereotactic body radiation therapy (SBRT) requires images that allow a more precise delineation of the tumor and its movement. The free breathing CT does not contain information on the variable electron density over time. The objective of this study is to analyze the CT mode that provides the best estimation of the tumor movement and the most appropriate image set for the calculation of the dose distribution image.

Material and Methods: 10 patients were retrospectively investigated. For each patient, a retrospective 4DCT was acquired using a Brilliance 16-slice scanner. From the 4DCT study, 10 respiratory phases, an average CT and a maximum intensity projection (MIP) were reconstructed. The gross tumor volumes (GTV) were delineated in each image set of the 4DCT using a MIM® 6.4 software. Three internal target volumes (ITV) were obtained, one from the union of GTVs delineated in each phase, another from the average CT and the last from the MIP reconstruction. Special care was taken with the window level selection when contouring. The size of the three ITVs was compared. The planning target volume

(PTV) was created adding a margin of 5 mm to the ITV .The dose distribution was optimized on the average CT prescribing a dose of 20 Gy per fraction delivering a total dose of 60 Gy to the PTV. The plans were calculated in a Phillips Pinnacle 9.10 planning system using conformal 3DRT and heterogeneity correction. The parameters obtained in the average CT optimized plan, were copied to the different image sets with identical monitor units to analyze the differences.

Results: The average GTV volume was 1.6 ± 1.1 cc. The ITV size is twice the lesion size in most of the cases except in those with higher breathing amplitude. The ITVs outlined in the average CT were smaller than those outlined in the 4DCT ranging from 0.1 cc, where there hardly was lesion movement, to 0.6 cc. The differences between the volumes were usually found in the cranio-caudal direction due to the higher movement of the lesion in this direction. The ITVs outlined in the MIP CT were equivalent to the 4DCT except in the cases where there was a higher density organ in the vicinity of the tumor. Respect to dose distribution, the dose of the organs at risk shows no significant differences in the different image sets. The V100 of the ITV presents significant variations up to 15% due to the variation in electron densities depending on the CT mode chosen. The V100 of the GTV calculated in each phase is greater than 97%.



Conclusion: We recommend using the ten phases of the 4DCT study for proper delineation of ITV. If the institution does not have the technology the CT average (low pitch CT) could be used selecting the appropriate window level and increasing margins. There is no significant difference in dose to organs at risk between the images modalities studied. Optimized planning in the average CT provides adequate coverage of GTV at different breathing phases.

PO-0854
Evaluation of a dedicated brain metastases treatment planning optimization for radiosurgery

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Purpose or Objective: Stereotactic radiosurgery alone has become a popular treatment option in the management of patients with brain metastases. Multi- or single-isocenter dynamic conformal arcs (DCA) and volumetric modulated arc therapy (VMAT) are two common used delivery techniques. Recently, a dedicated inverse optimized brain metastases treatment planning solution using single isocenter multiple DCA (SIDCA) has been developed, with intend to carefully balance normal tissue protection, target coverage and treatment speed. The purpose of the current study was to investigate the feasibility of this novel software and to benchmark it against well-established multi-isocenter DCA and single isocenter VMAT approaches.

Material and Methods: Ten previously treated patients were selected representing a variable number of lesions (1-8), range of target sizes and shapes most frequently observed in the practice of SRS for brain metastases. The original multi-isocenter DCA (MIDCA) were replanned with both single-isocenter VMAT approach and the novel brain metastases tool (Elements, Brainlab AG, Germany). The treatment dose was 20 Gy at the 80% prescription isodose. For all the plans, the dose to the surrounding healthy brain tissue (brainstem, cochlea, optical nerve, eyes and lens) was optimized to minimize normal tissue complications. The plans were evaluated by calculation of Paddick conformity and gradient index, and the volume receiving 10 and 12 Gy indicating risk of radionecrosis.

Results: All plans were judged clinically acceptable, but differences were observed in the dosimetric parameters. The mean conformity of the automated single-isocenter planning tool (SIDCA) compared similarly to the established MIDCA and VMAT treatment techniques (CISIDCA=0.65 ± 0.08, CIMIDCA=0.66 ±0.07 and CIVMAT=0.67 ±0.16). Comparable mean dose fall off was observed between SIDCA and MIDCA (GISIDCA =3.9 ± 1.4 and GIMIDCA=4.5 ± 1.6). On the other hand, the GI of the VMAT plans (GIVMAT=7.1 ± 3.1) were significantly higher compared to the SIDCA. The V10 and V12 were significantly higher for VMAT plans (V10VMAT=67.9 ±55.9cc, V12VMAT=46.3 ±35.9cc) ($p<0.05$) compared to MIDCA (V10MIDCA=49.0 ±38.1cc, V12MIDCA=35.6 ±26.4cc) and SIDCA (V10=48.5 ± 35.9cc, V12=36.3 ± 27.1cc).

Conclusion: The automated brain metastases treatment planning element, based on an inversely-optimized SIDCA approach, revealed comparable results to the general accepted MIDCA approach. By reducing the time on planning, patient and treatment setup, this software tool improves the planning and delivery efficiency while preserving the plan quality of the MIDCA technique and lowering low dose spread of the VMAT approach, suggesting that this novel software offers the best of both worlds (i.e. efficient single-isocenter DCA delivery).

PO-0855
Flattening Filter Free VMAT for extreme hypofractionation of prostate cancer

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Purpose or Objective: To examine the feasibility of flattening filter free (FFF) volumetric modulated arc therapy (VMAT) for extreme hypofractionation of prostate cancer and investigate the potential decrease in treatment time per fraction while preserving or improving the treatment quality. To investigate the impact of intrafractional prostatic displacement.

Material and Methods: Single arc treatment plans with photon beam qualities 10 MV with flattening filter (FF), 6 MV FFF and 10 MV FFF were created for nine patients treated with conventional fractionation (78 Gy, 2 Gy/fraction) and hypofractionation (42.7 Gy, 6.1 Gy/fraction), respectively. Dose-volume histograms (DVH) for all beam qualities were statistically evaluated using a paired sample Student's t-test. Treatment delivery was evaluated through measurements on a Varian TrueBeam™ using a Delta4 PT system (ScandiDos AB). The beam-on time for each plan was recorded. A motion study, including one FF and one FFF hypofractionated treatment plan, was also performed using the HexaMotion (ScandiDos AB) and with trajectory data from six authentic prostate movement patterns.

Results: All treatment plans were approved by a senior radiation oncologist. Evaluating the DVHs, no significant differences between beam qualities or between fractionation schedules were observed. All objectives were met for all plans. At the treatment delivery all plans passed the gamma criterion 3%, 2 mm with a pass rate of 98.8% or higher. The beam-on time for all conventional treatment plans was 1.0 minute. The mean beam-on time was 2.3 minutes for the hypofractionated 10 MV FF plan, 1.3 minutes for the 6 MV FFF and 1.0 minute for the 10 MV FFF. In the motion study, no or little effect was observed on the pass rate for displacements